

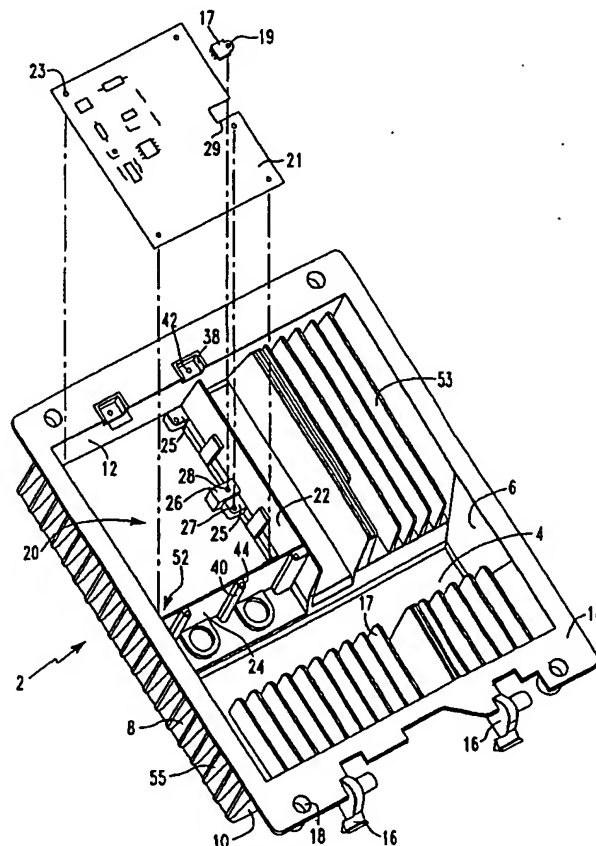


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup> :</b> <b>H05K 9/00</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 98/44773</b> <b>(43) International Publication Date:</b> 8 October 1998 (08.10.98)
<b>(21) International Application Number:</b> PCT/US98/05888 <b>(22) International Filing Date:</b> 28 March 1998 (28.03.98)  <b>(30) Priority Data:</b> 08/828,475                      31 March 1997 (31.03.97)                      US  <b>(71) Applicant:</b> SCIENTIFIC-ATLANTA, INC. [US/US]; One Technology Parkway South, Norcross, GA 30092 (US). <b>(72) Inventor:</b> McCANN, Andrew, F.; 1061 Forest Park Lane, Suwanee, GA 30174 (US).  <b>(74) Agents:</b> GARDNER, Kelly, A. et al.; Scientific-Atlanta, Inc., One Technology Parkway South, Norcross, GA 30092 (US).		<b>(81) Designated States:</b> European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).  <b>Published</b> <i>With international search report.</i>

**(54) Title:** APPARATUS FOR CONTAINING POWER SUPPLY TO REDUCE RF EMISSIONS**(57) Abstract**

An apparatus for housing a power supply comprises a top member (4) and pairs of opposed end and side walls (10, 12, 6, 8). A compartment (20) is formed within and of one piece construction with the top member. A mounting means (25) is formed in the compartment to which a power supply switch transistor can be secured. A cover for the compartment comprises a substantially planar member and a plurality of flanges extending away from the planar member along its edges. Each flange has a dome-shaped projection extending outwardly from the surface of the flange which provides a positive point to point electrical contact with the walls of the compartment when the cover is secured to the top member.



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**APPARATUS FOR CONTAINING POWER SUPPLY  
TO REDUCE RF EMISSIONS**

**INTRODUCTION**

The present invention is directed to radio frequency (RF) component housings and, more particularly, to RF component housings having enhanced thermal conductivity and electromagnetic shielding.

**BACKGROUND**

Radio frequency (RF) components are generally contained within housings designed to effectively dissipate the heat generated by the RF components and provide electromagnetic shielding to reduce the transmission of RF energy.

Housings for RF components generally comprise a base and a lid to enclose the base. One common component contained in such housings is an RF amplifier which requires a separate power supply. Power supplies are typically contained within a separate enclosure which is in turn secured within the interior of the housing. The switching transistors of power supplies generate large amounts of heat which must be removed from the housing in order to preserve the reliability of the devices. Such housings having separate enclosures for the power supplies exhibit less than desirable dissipation of the heat generated within the housing as well as excessive RF energy losses. Covers for such housings also exhibit RF energy losses due to a lack of adequate metal to metal contact.

One housing cover is proposed in U.S. patent 5,566,055 to Salvi, Jr. The housing of Salvi, Jr. has a plurality of compartments formed within the housing cover. Salvi, Jr. has no provision for securing components directly to the cover of the housing and therefore has less effective heat dissipation for the components contained within the housing.

One housing and associated cover is proposed in U.S. patent 4,759,466 to Chase et al. The cover of Chase et al. has a plurality of tabs extending from its edges and dome-shaped projections protruding from outer surfaces of the tabs. The housing has a plurality of slots at upper edges of walls of the housing which engage the tabs. Each slot has a cavity which engages a corresponding projection with the radius of the cavity being larger than the radius of the corresponding projection. The mating surface of the tab is provided by the projection and the exterior surface of the tab, thus the point of contact of the tab with the slot is either a linear contact surface or a ring contact surface and not primarily a positive point to point contact. The housing of Chase et al. is complex and does not provide for the mounting of heat generating components directly to the cover of the housing and therefore is less effective at dissipating heat generated by such components contained within the housing.

It is an object of the present invention to provide an improved apparatus for housing a power supply which reduces or wholly overcomes some or all of the aforesaid difficulties inherent in prior known devices. Particular objects and advantages of the invention will be apparent to those skilled in the art, that is, those who are knowledgeable and experienced in this field of technology, in view of the following disclosure of the invention and detailed description of certain preferred embodiments.

### SUMMARY

The principles of the invention may be used to advantage to provide an improved lid for a housing containing a power supply comprising a compartment formed of one piece construction with the lid. A mounting means is formed in the compartment to which a power supply switch transistor can be secured. A cover for the compartment comprises a substantially planar member and a plurality of flanges extending away from the planar member along its edges. Each flange has a dome-shaped projection extending outwardly from the surface of the flange which provides a positive point to point electrical contact with the walls of the compartment when the cover is secured to the lid.

The principles of the invention may also be used to advantage to provide a method of containing a power supply to reduce RF emissions and dissipate heat comprising the steps of providing a lid for an RF housing having a top member and opposed end and side walls of one-piece construction with the top member, forming a compartment of one-piece construction with the top member, the compartment having mounting means to secure the power supply therein, mounting the power supply to the mounting means, and enclosing the compartment with a cover comprising a substantially planar member and a plurality of flanges extending generally perpendicular to the surface plane of the planar member, the flanges having a projection extending from a surface thereof to provide a point to point electrical contact with a surface of the compartment.

From the foregoing disclosure, it will be readily apparent to those skilled in the art, that is, to those who are knowledgeable or experienced in this area of technology, that the present invention provides a significant technological advance. The lid having a compartment formed therein and of one-piece construction with the lid provides

increased thermal conductivity for power supply switching transistors mounted to the lid as well as increased electromagnetic shielding. The cover having a plurality of flanges each having a dome-shaped projection extending from an outer surface thereof provides additional electromagnetic shielding for the compartment. These and further additional features and advantages of the invention will be further understood from the following detailed disclosure of certain preferred embodiments.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

Certain preferred embodiments are described in detail below with reference to the appended drawings wherein:

Fig. 1 is a schematic perspective view of the lid of the present invention having a compartment for containing a power supply;

Fig. 2 is a schematic perspective view of the cover for the power supply compartment of Fig. 1;

Fig. 3 is a schematic elevation view of the cover of Fig. 2 showing the flanges and associated projections; and

Fig. 4 is a schematic perspective view of a housing base of the present invention containing an amplifying circuit..

The figures referred to above are not drawn necessarily to scale and should be understood to present a simplified representation of the invention, illustrative of the basic principles involved. Some features of the RF housing lid depicted in the drawings have been enlarged or distorted relative to others to facilitate explanation and understanding. The same reference numbers are used in the drawings for similar or identical components

and features shown in various alternative embodiments. RF housing lids as disclosed above, will have configurations and components determined, in part, by the intended application and environment in which they are used.

### **DETAILED DESCRIPTION OF CERTAIN PREFERRED EMBODIMENTS**

Unless otherwise stated, or otherwise clear from the context below, directional references used here are based on the orientation of components and assemblies shown in the appended drawings. These directional references assume a lid for a housing containing RF components. The lid is depicted in Fig. 1 in an inverted manner such that downwardly refers to a direction generally away from the top of the lid toward the top of the page. Upwardly, therefore, refers to a direction generally away from the top of the lid toward the bottom of the page. Outwardly refers to a direction generally away from the exterior of the walls of the lid and inwardly refers to a direction generally away from the walls toward the interior of the lid.

RF components such as RF amplifiers are typically contained within housings comprising a base and a lid. The following description will show and describe the lid and the base for such a housing. Housing lid 2 comprising top 4 and pairs of opposed side walls 6, 8 and end walls 10, 12 extending downwardly from and formed of one-piece construction with top 4, is shown in Fig. 1. A skirt 14 is formed at lower edges of side walls 6, 8 and end walls 10, 12 and provides a mating surface for the base 57 of the housing, shown in Fig. 4. Base 57 comprises bottom 59, end walls 61, 63 and side walls 65, 67. Skirt 69 is formed along upper edges of the walls to mate with skirt 14 of lid 2. A printed circuit board 70 is mounted within base 57. Printed circuit board 70, in a

preferred embodiment employs conventional amplifying circuitry in order to amplify a signal such as a television cable signal. Such amplifying circuits are well known and examples of such circuits will become readily apparent to those skilled in the art given the benefit of this disclosure. As seen in Fig.1, a fastening means comprising hinge members 16 and mounting holes 18 is provided along skirt 14 for rotatably and positively, respectively, securing lid 2 to base 57 of the housing. Hinge members 16 engage mating hinge members 71 on the base 57 allowing lid 2 to be easily opened and closed. Fasteners such as screws pass through mounting holes 18 and engage mounting holes 73 in the base 57 thereby positively securing lid 2 to the base.

In a preferred embodiment, power supply compartment 20 is formed in and is of one-piece construction with lid 2. Compartment 20 comprises compartment side wall 22 and compartment end wall 24, compartment side wall 22 being opposed to side wall 8 of lid 2 and compartment end wall 24 being opposed to end wall 12 of lid 2. Thus, compartment 20 has a generally rectangular shape. Mounts 25 are formed within compartment 20, extend from top 4 and are of one-piece construction with lid 2. A printed circuit board 21 of the power supply is secured within compartment 20 via screws or other suitable fasteners which extend through apertures 23 in printed circuit board 21 and engage apertures 27 formed in mounts 25, as shown by the dashed lines. Preferably a mount 25 is formed in each corner of the compartment 20 and one mount 25 is formed along a central portion of side wall 22. Mounting means such as a mounting block 26 is also formed within compartment 20, extends from top 4, and is of one-piece construction with lid 2. Preferably mounting block 26 is proximate the mount 25 located along side wall 22. A power supply switching transistor 17 extends through gap 29



formed in printed circuit board 21 and is secured to mounting block 26 via a fastener, such as a screw, which extends through aperture 19 in switching transistor 17 and engages aperture 28 formed in mounting block 26, as shown by the dashed lines. Since mounting block 26 is of one-piece construction with lid 2, the switching transistor 17 is directly connected to lid 2, thereby providing increased thermal performance by allowing the heat generated by switching transistor 17 to more effectively reach the exterior of the lid where it is dissipated to the surrounding environment. Compartment 20, being of one-piece construction with lid 2, additionally provides improved electromagnetic shielding over prior art devices having separate power supply enclosures, as well as reduced manufacturing costs and increased manufacturability.

Cover 30 comprises substantially planar member 32, as seen in Fig. 2, and is designed to enclose compartment 20 and provide electromagnetic shielding which will retain RF energy within compartment 20. Mounting members are provided on planar member 32, such as tabs 34 having apertures 36 and extending from planar member 32. Tabs 34 mate with corresponding recesses 38 formed in end wall 12 and mounting supports 40 formed along end wall 24. Cover 30 is then secured to compartment 20 via fasteners, such as screws, which extend through apertures 36 and engage apertures 42 formed in recesses 38 and apertures 44 formed in mounting supports 40. Flanges 46 extend upwardly from outer edges of planar member 32 in a direction generally perpendicular to the surface plane of planar member 32, thereby forming a generally box shaped cover. Dome-shaped projections 48 extend outwardly from the surface of each flange 46 proximate an end thereof, as can be seen in Fig. 3. When cover 30 is secured to lid 2, flanges 46 extend upwardly into and within compartment 20. Flanges 46 are

resilient members which exert a spring-like action outwardly toward the side and end walls of the compartment 20, thereby resiliently engaging these walls. In a preferred embodiment, flanges 46 are of one-piece construction with planar member 32. Projections 48 contact side wall 8, compartment side wall 22, end wall 12, and compartment end wall 24 providing a positive point to point electrical contact with lid 2 at multiple points along the periphery of cover 30. The independent springing action of each flange 46 thereby accounts for any irregularities in the walls and maintains the positive electrical contact formed between projections 48 and the walls. Such positive contact at multiple points along the periphery of cover 30 advantageously provides increased shielding which reduces RF energy loss from the power supply compartment. The number and size of flanges 46 will become readily apparent to those skilled in the art, given the benefit of this disclosure. Gap 50 is formed along one edge of cover 30 by removing one flange 46. Gap 50 provides a passage for a power cable which connects the power supply to other components in the housing, the power cable also passing through a corresponding gap 52 formed in end wall 24. In a preferred embodiment a choke is provided on the power cable.

In a preferred embodiment a plurality of fins 53 are provided on the interior of the lid 2 to improve heat absorption from components in the housing while the exterior of the lid is provided with a plurality of fins 55 to aid in dissipation of heat from the lid 2. Such an embodiment is further described in U.S. Application Serial No. 08/657,200 filed on June 3, 1996, the contents of which are incorporated herein by reference.

In a preferred embodiment the lid is formed of cast aluminum alloy while the cover is comprised of steel. In other embodiments the particular components may be

formed of beryllium copper or other suitable materials which exhibit suitable thermal performance, electromagnetic shielding, and mechanical characteristics. It is important that regardless of the material used the flanges are resilient and provide a spring-like action which maintains contact with the walls of the compartment.

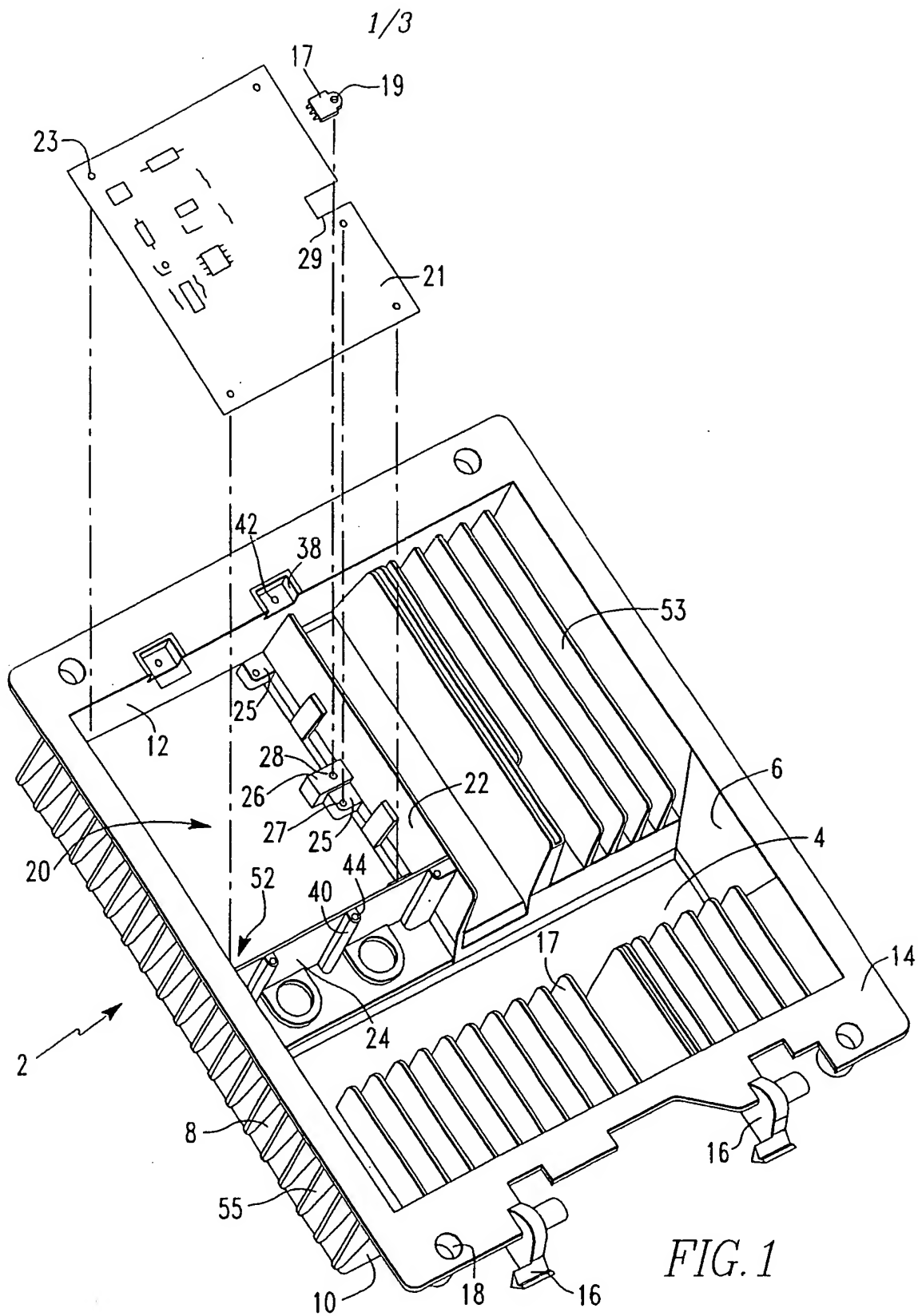
In light of the foregoing disclosure of the invention and description of certain preferred embodiments, those who are skilled in this area of technology will readily understand that various modifications and adaptations can be made without departing from the true scope and spirit of the invention. All such modifications and adaptations are intended to be covered by the following claims.

I claim:

1. An apparatus for containing a power supply comprising, in combination:
  - a top member;
  - opposed end and side walls formed of one-piece construction with the top member;
  - a compartment formed of one-piece construction with the top member to house the power supply; and
  - mounting means formed in the compartment and of one-piece construction with the top member to secure the power supply within the compartment.
2. An apparatus in accordance with claim 1 further comprising a cover to enclose the compartment, the cover comprising:
  - a substantially planar member;
  - a plurality of flanges extending from the planar member; and
  - a projection extending from a surface of each of the plurality of flanges.
3. An apparatus in accordance with claim 2 wherein the plurality of flanges extend in one direction generally perpendicularly to the surface plane of the planar member.
4. An apparatus in accordance with claim 2 wherein the plurality of flanges resiliently engage surfaces of the power supply compartment when the cover encloses the compartment.

5. An apparatus in accordance with claim 4 wherein each of the projections is on an outer surface of its corresponding flange and the plurality of flanges resiliently engage interior surfaces of the walls of the power supply compartment when the cover encloses the compartment.
6. An apparatus in accordance with claim 2 wherein the projections are substantially dome-shaped.
7. An apparatus in accordance with claim 2 further comprising at least one mounting member on the cover to secure the cover to the compartment.
8. An apparatus in accordance with claim 7 further comprising mounting supports formed along the compartment and recesses formed along the compartment, wherein the at least one mounting member comprises tabs formed to mate with and be secured to the mounting supports and the recesses.
9. An apparatus in accordance with claim 1 wherein the compartment is formed by one of the end walls, one of the side walls, a compartment side wall extending from and of one-piece construction with the top, and a compartment end wall extending from and of one-piece construction with the top.
10. An apparatus in accordance with claim 1 wherein the mounting means comprises

a mounting block having an aperture therein.



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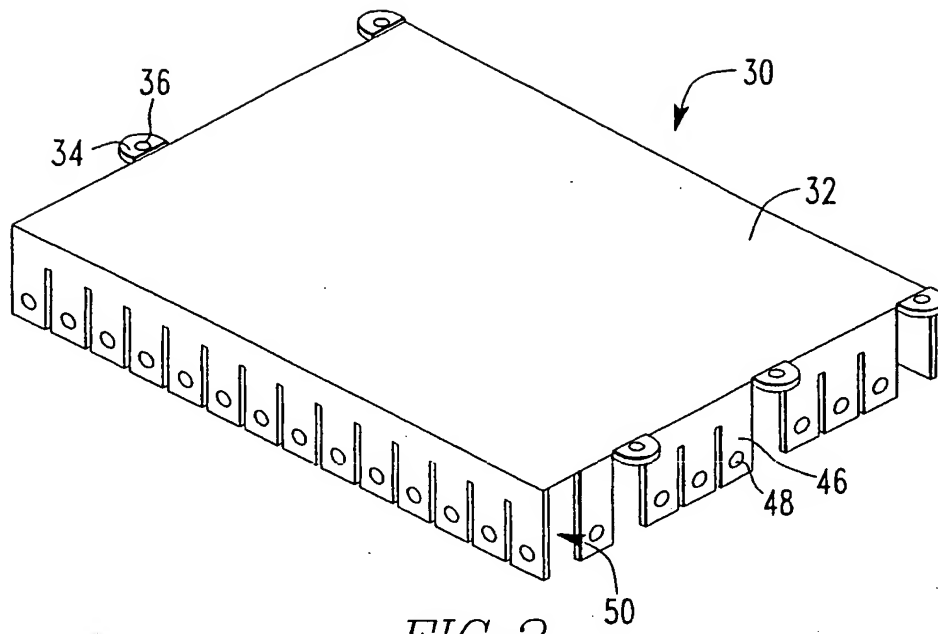


FIG. 2

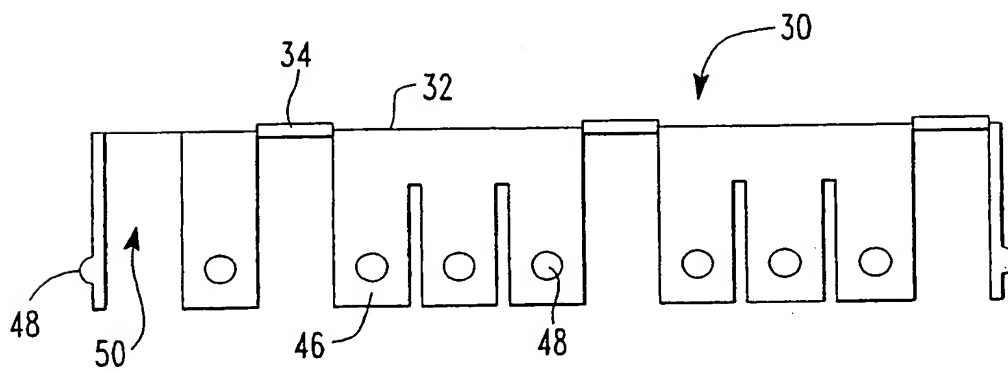


FIG. 3



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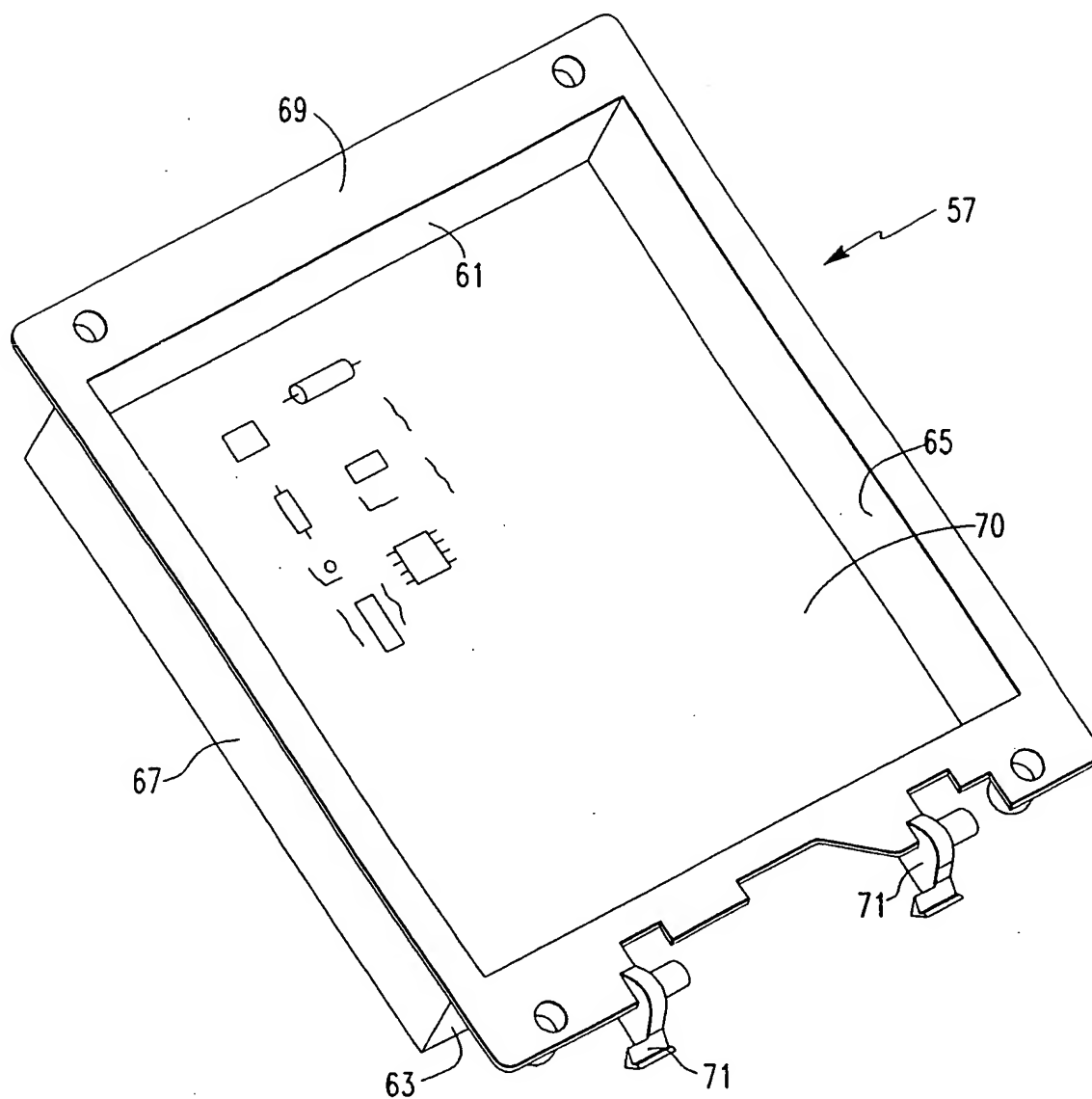


FIG. 4

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US98/05888

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(6) : H 05K 9/00

US CL : 174/35R

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 174/35R, 35MS, 51; 361/752, 753, 799, 800, 816, 818

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,353,202 (ANSELL ET AL) 04 OCTOBER 1994 (04/10/94), see figure 2.	1, 2, 4, 5, 7, 9
X	US 3,909,726 (DOBROVOLNY ET AL) 30 SEPTEMBER 1975 (30/09/75), see figure 3.	1-5, 9
X	US 5,121,296 (HSU) 09 JUNE 1992 (08/06/92), see figure 1.	1-5, 9

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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Date of the actual completion of the international search

08 MAY 1998

Date of mailing of the international search report

22 JUL 1998

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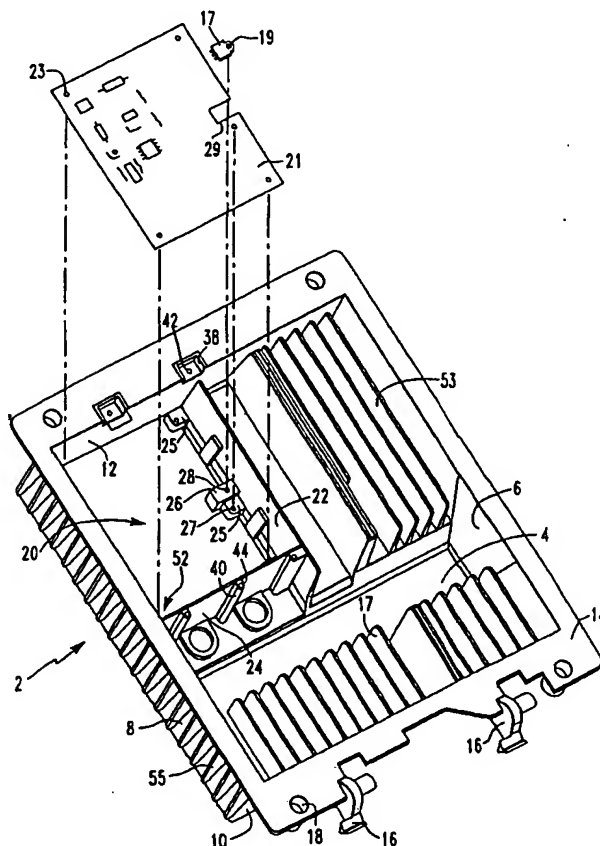
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**(54) Title:** APPARATUS FOR CONTAINING POWER SUPPLY TO REDUCE RF EMISSIONS

**(57) Abstract**

An apparatus for housing a power supply comprises a top member (4) and pairs of opposed end and side walls (10, 12, 6, 8). A compartment (20) is formed within and of one piece construction with the top member. A mounting means (25) is formed in the compartment to which a power supply switch transistor can be secured. A cover for the compartment comprises a substantially planar member and a plurality of flanges extending away from the planar member along its edges. Each flange has a dome-shaped projection extending outwardly from the surface of the flange which provides a positive point to point electrical contact with the walls of the compartment when the cover is secured to the top member.



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## AMENDED CLAIMS

[received by the International Bureau on 22 September 1998 (22.09.98);  
original claims 1-10 replaced by amended claims 1-11 (3 pages)]

1. An apparatus for containing a power supply comprising, in combination:
  - a top member;
  - opposed end and side walls formed of one-piece construction with the top member;
  - a compartment formed of one-piece construction with the top member to house the power supply, wherein the compartment is electrically conductive;
  - mounting means formed in the compartment and of one-piece construction with the top member to secure the power supply within the compartment; and
  - an electrically conductive cover to enclose the compartment, the electrically conductive cover comprising:
    - a substantially planar member;
    - a plurality of flanges extending from the planar member; and
    - an projection extending from a surface of each of the plurality of flanges, wherein the projection is electrically conductive, and wherein the projection resiliently engages a surface of the compartment when the electrically conductive cover is assembled with the compartment such that an electrical connection is provided between the projection and the compartment.
2. An apparatus in accordance with claim 1 wherein the plurality of flanges extend in one direction generally perpendicularly to the surface plane of the planar member.

3. An apparatus in accordance with claim 1 wherein the plurality of flanges resiliently engage surfaces of the power supply compartment when the cover encloses the compartment.
4. An apparatus in accordance with claim 3 wherein a projection is formed on each of the flanges and the projections resiliently engage interior surfaces of the walls of the power supply compartment when the cover encloses the compartment.
5. An apparatus in accordance with claim 1 wherein the projections are substantially dome-shaped.
6. An apparatus in accordance with claim 1 further comprising at least one mounting member on the cover to secure the cover to the compartment.
7. An apparatus in accordance with claim 6 further comprising mounting supports formed along the compartment and recesses formed along the compartment, wherein the at least one mounting member comprises tabs formed to mate with and be secured to the mounting supports and the recesses.
8. An apparatus in accordance with claim 1 wherein the compartment is formed by one of the end walls, one of the side walls, a compartment side wall extending from and of one-piece construction with the top, and a compartment end wall extending from and of one-piece construction with the top.

9. An apparatus in accordance with claim 1 wherein the mounting means comprises a mounting block having an aperture therein.
10. An apparatus for containing a power supply comprising, in combination:
- a top member;
  - opposed end and side walls formed of one-piece construction with the top member;
  - a compartment that is electrically conductive and that is formed of one-piece construction with the top member to house the power supply;
  - mounting means formed in the compartment and of one-piece construction with the top member to secure the power supply within the compartment;
  - a cover for the compartment comprising a substantially planar member;
  - a plurality of flanges extending in one direction generally perpendicularly to the surface plane of the planar member; and
  - a dome-shaped, electrically conductive projection extending outwardly from the surface of each of the flanges to provide electrical contact with a substantially planar surface of the power supply compartment by applying a pressure thereto to resiliently engage the substantially planar surface of the power supply compartment.
11. An apparatus in accordance with claim 10 further comprising at least one mounting member extending from the planar member to secure the cover to the power supply compartment.



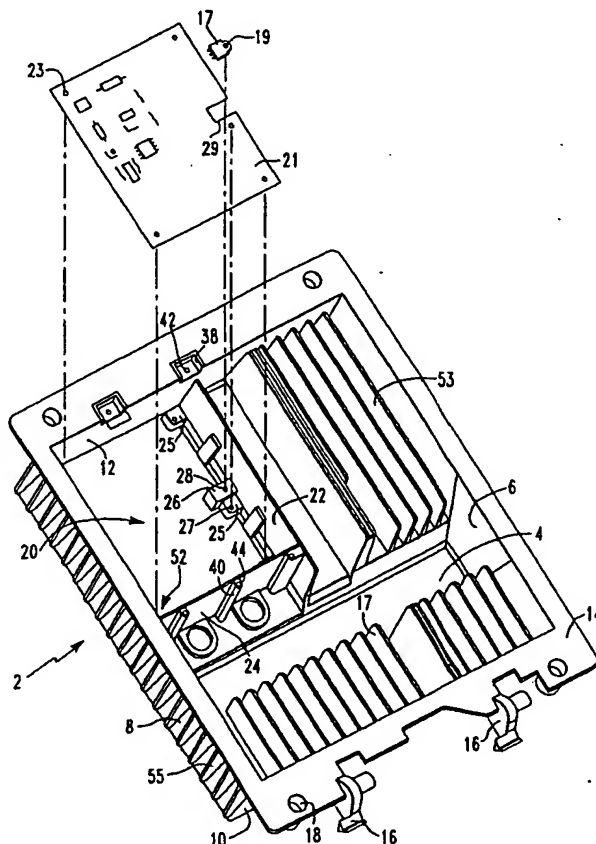
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : <b>H05K 9/00</b>	<b>A1</b>	(11) International Publication Number: <b>WO 98/44773</b> (43) International Publication Date: <b>8 October 1998 (08.10.98)</b>
<p>(21) International Application Number: <b>PCT/US98/05888</b></p> <p>(22) International Filing Date: <b>26 March 1998 (26.03.98)</b></p> <p>(30) Priority Data: <b>08/828,475</b>                      <b>31 March 1997 (31.03.97)</b>                      <b>US</b></p> <p>(71) Applicant: <b>SCIENTIFIC-ATLANTA, INC. [US/US]; One Technology Parkway South, Norcross, GA 30092 (US).</b></p> <p>(72) Inventor: <b>McCANN, Andrew, F.; 1061 Forest Park Lane, Suwanee, GA 30174 (US).</b></p> <p>(74) Agents: <b>GARDNER, Kelly, A. et al.; Scientific-Atlanta, Inc., One Technology Parkway South, Norcross, GA 30092 (US).</b></p>		<p>(81) Designated States: <b>European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).</b></p> <p><b>Published</b> <i>With international search report.</i> <i>With amended claims.</i></p> <p><b>Date of publication of the amended claims:</b> <b>10 December 1998 (10.12.98)</b></p>

(54) Title: **APPARATUS FOR CONTAINING POWER SUPPLY TO REDUCE RF EMISSIONS**

(57) Abstract

An apparatus for housing a power supply comprises a top member (4) and pairs of opposed end and side walls (10, 12, 6, 8). A compartment (20) is formed within and of one piece construction with the top member. A mounting means (25) is formed in the compartment to which a power supply switch transistor can be secured. A cover for the compartment comprises a substantially planar member and a plurality of flanges extending away from the planar member along its edges. Each flange has a dome-shaped projection extending outwardly from the surface of the flange which provides a positive point to point electrical contact with the walls of the compartment when the cover is secured to the top member.





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